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PATENT SPECIFICATION

637,319

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PROVISIONAL SPECIFICATION

Improvements in or relating to Pulverised Fuel Supply Systems

We, JOHN THOMPSON WATER TUBE BOILERS LIMITED, a Company organised under the laws of Great Britain, and JOHN PHILIP O'REILLY, a Subject of the King of Great Britain, both of Ettingshall Engineering Works, Wolverhampton, in the County of Stafford, do hereby declare the nature of this invention to be as follows:—

This invention concerns pulverised fuel supply systems for the distribution of pulverised fuel to the burners of furnaces or other consuming devices (such systems being hereinafter referred to for convenience as fuel distributors) wherein the pulverised fuel is carried by a current of air along a trunk or duct from which branch trunks or ducts divide to take the fuel to the several consuming devices. One of the main difficulties which has hitherto been encountered in such fuel distributors is to ensure equal distribution of the pulverised fuel to all the consuming devices. In particular, it is sometimes found that, when the load on a multi-burner furnace is modified, one or more of the burners become starved of fuel on light load, resulting in the formation of a black spot or zone with the consequent detrimental unevenness of heat distribution. This is especially apparent in fuel distribution systems in which the main trunk from the pulverising mill is arranged at an inclination to the vertical over a considerable portion of its length. In such a trunk the particles of pulverised fuel tend to become concentrated along one or more of the lower layers of the stream through the trunk, causing variations in the concentration of fuel in the various branches. The difficulty is enhanced by the fact that the distribution of fuel concentration across on a cross-section of the trunk may vary with variation in load.

Various means have been proposed for overcoming this difficulty. For example, it has been proposed to sub-divide a trunk, immediately before a junction, into a plurality of layers in one direction, unite alternate layers into two streams, again subdivide these streams into a plurality of layers in a direction at right angles, and again unite alternate layers into two streams. Alternate streams from this second subdivision are then united to form two resultant branches in which the distribution of pulverised fuel is substantially equal. If correctly designed the desired result may be obtained with a high degree of uniformity but, the apparatus described is not adjustable and moreover is complicated and costly to manufacture.

It is an object of the present invention to attain an equal distribution of pulverised fuel to all branches and to each burner or other consuming device in a simple and efficient manner. It is a further object of the invention to provide means for controlling the distribution of the pulverised fuel to a plurality of branches, for example in accordance with variations in load.

According to the present invention a pulverised fuel distributor comprises a deflector member mounted internally of the trunk before a junction therein, and means for adjusting the degree of projection of the deflector member into the stream of pulverised fuel passing to the junction so as to produce the desired distribution thereof to the branches.

Preferably, the deflector member is mounted on an internal wall of the trunk, and a plurality of members may be mounted at spaced intervals across the width of the trunk.

Advantageously, deflector members are mounted on a plurality of walls of a trunk of polygonal cross-section, and may be arranged in sets each having independent means for the adjustment thereof.

Conveniently, a set of deflector members may be mounted on a common spindle about which they can be pivoted, or on which they may be secured for common pivotal movement. Two such sets of deflector members may be mounted on opposite walls of a rectangular section trunk at the same cross-section thereof, and a further two sets may be similarly mounted on the other walls of the trunk, at a position clear of the first set.

In order that the invention may be more clearly understood one example of a construction in accordance therewith, as fitted to a vertical rectangular trunk adjacent a bifurcation thereof, will now be described by

way of example.

The main trunk from a coal pulverising mill to a distribution point is of rectangular cross-section and runs vertically immediately before the junction at which it divides into two branches supplying pulverised coal to separate furnaces or other consuming devices. A length of the main trunk immediately before the junction is divided axially into two short equal sections. The section adjacent the junction has a pair of opposite walls outwardly flared in the downward direction over substantially the whole of its length. Within this flared part are mounted a pair of opposed flat liners or plates having their inward-facing surfaces continuous with the corresponding wall of the main section of the trunk. Each liner extends from a point adjacent the upper end of the flared portion of the section to a point adjacent its lower end, and at the bottom of the outer surface are mounted journal bearings for a horizontal transverse shaft one end of which extends through one side wall of the trunk and has keyed or pinned thereto a control lever for rotating the shaft through an angle of approximately 45°.

Each liner is apertured or recessed on its inward face to accommodate a plurality of equally spaced deflector fingers whose lower ends are secured on bosses keyed or otherwise rigidly attached to the shaft. The lengths of these deflector fingers are approximately equal and somewhat greater than half the width of the trunk between the liners. On the outer surface of the trunk wall through which the spindles project are mounted quadrant plates, with which the control levers are adjustably engageable, clamping means being provided to maintain any desired angular setting of the spindle. By this means, the deflector fingers on each spindle may be adjusted to project into the flow of pulverised coal through the trunk at any desired inclination between zero (when they are nested in the liner with their inward-facing surfaces flush with the inward-facing surface thereof) to a maximum position of approximately 45° in which position their tips lie on or close to the vertical axial plane of the trunk.

Below this section of main trunk is a similarly constructed section having two sets of adjustable deflectors, the whole being, however, rotated about the vertical axis of the trunk through 90° with respect to the section immediately above it.

In use, when pulverised coal is drawn or blown through the main trunk and is to be divided at the junction to feed say, two separate burners in a furnace or two separate sets of burners in different furnaces, the deflector fingers are adjusted empirically until the proportions of pulverised coal in the two branches are equal. This equalisation is brought about by the deflection across the main stream immediately ahead of the junction of alternate "layers" of the stream by one or more of the sets of fingers so that, if there is a greater concentration of pulverised coal particles adjacent one of the walls of the main trunk, this concentration is effectively broken up by the deflector fingers mounted on this wall, the oblique currents are set up in the main streams which result in an equal division at the junction of the particles of coal in the main stream. The device thus operates effectively to produce the same result as is obtained by the already known method of sub-dividing the main stream into layers, first across one section and then across a section at right angles thereto.

It will be understood that it may not always be necessary to provide two short sections arranged at 90° to each other and each having two sets of deflector fingers or plates. For example, it may be found in practice that for a given trunk under all conditions of load the concentration of entrained particles of pulverised fuel is always greatest along one particular wall of the trunk. In such circumstances it may be quite sufficient to employ only one set of deflector fingers before the junction to project into the layer adjacent this wall and to deflect alternate sections of it across the main stream at such an angle as to produce an equal distribution of the pulverised fuel in the two branches. On the other hand, two sets of fingers at right angles to each other may be all that is required to produce the desired result. In this case one set of fingers would normally be mounted beyond the other in the main trunk.

The angle at which the deflector fingers are set with respect to the axis of flow may be either manually or automatically adjustable. Thus, it may be found that the angle is a simple function of the load on the main trunk, and means sensitive to this load may be arranged to move the fingers to the correct inclination.

The deflector fingers in two oppositely disposed sets are preferably staggered in relation to each other, each finger of one set being located opposite a gap between two adjacent fingers of the other set. Thus the deflected current set up by a finger is caused to interleave with similar but oppositely directed currents set up by fingers of the other set. In this way intimate mixing of the particles of pulverised fuel in the main stream is promoted.

The deflector fingers or plates may be of any convenient material ,and the number of

plates in a set may be varied to suit local conditions. The fingers of a set may also be arranged—for example on sleeves on the spindle—to be rotated independently of the other members of the set if so desired.

The shape of the fingers may be other than flat, or they may be constituted by flat plates whose planes are skewed or twisted with respect to the axis of the spindle on which they are mounted to give a still further modification of the flow in the main trunk. Alternatively, they may be designed to have a length (measured in the direction of flow) which is relatively great compared with their thickness; or they may be sector-shaped in side elevation.

Instead of being hinged, the fingers may be arranged to slide through slots in a wall of the trunk, or they may be of telescopic construction and housed in a recess in the wall of the trunk to avoid the necessity of providing air-tight seals around the fingers where they pass through the wall.

Dated this 1st day of July, 1947.

For the Applicants,
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75, Victoria Street, London, S.W.1,
Chartered Patent Agents.

COMPLETE SPECIFICATION

Improvements in or relating to Pulverised Fuel Supply Systems

We, JOHN THOMPSON WATER TUBE BOILERS LIMITED, a Company organised under the laws of Great Britain, and JOHN PHILIP O'REILLY, a Subject of the King of Great Britain, both of Ettingshall Engineering Works, Wolverhampton, in the County of Stafford, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention concerns pulverised fuel supply systems for the distribution of pulverised fuel of the kind (hereinafter referred to for convenience as pulverised fuel systems of the kind described) comprising a main trunk or duct along which the pulverised fuel is carried by a current of air, and a junction at which one or more branch trunks or ducts diverge from the main trunk for supplying fuel to furnace burners or other consuming devices. For the purposes of this specification, the junction between a main and a branch trunk or duct is regarded as the point beyond (i.e. downstream from) which the said main and branch trunks or ducts have distinct and separate boundaries. It will be understood that the terms "main" and "branch" used above have only a relative significance, and are not intended as absolute definitions of the size or importance of a trunk or duct in any given system.

One of the main difficulties which has hitherto been encountered in pulverised fuel systems of the kind described is to ensure equal distribution of the pulverised fuel to all the consuming devices. In particular, it is sometimes found that, when the load on a multi-burner furnace is modified, one or more of the burners become starved of fuel resulting in the formation of a black spot or zone with the consequent detrimental unevenness of heat distribution. This is especially apparent in pulverised fuel systems in which the main trunk from the pulverising mill is arranged at an inclination to the vertical over a considerable portion of its length. In such a trunk the particles of pulverised fuel tend to become concentrated along one or more of the lower layers of the stream through the trunk, causing variations in the concentration of fuel in the various branches. The difficulty is enhanced by the fact that the distribution of fuel concentration across a cross-section of the trunk may vary with variation in load.

Various means have been proposed for overcoming this difficulty. For example, it has been proposed to subdivide a trunk, immediately before a junction, into a plurality of layers in one direction, unite alternate layers into two streams, again subdivide these streams into a plurality of layers in a direction at right angles to that of the first subdivision, and again unite alternate layers into two streams. Alternate streams from this second subdivision are then united to form two resultant branches in which the distribution of pulverised fuel is substantially equal. If correctly designed the desired result may be obtained with a high degree of uniformity but the apparatus described is not adjustable, and moreover is complicated and costly to manufacture.

It is an object of the present invention to attain an equal distribution of pulverised fuel to all branches and to each burner or other consuming device in a simple and efficient manner. It is a further object of the invention to provide means for controlling the distribution of the pulverised fuel to a plurality of branches, for example, in accordance with variations in load, by modifying the fuel concentration in a layer or layers of the stream before it reaches a junction.

According to the present invention, in a pulverised fuel system of the kind described a fuel distributor is located upstream from the junction and comprises a deflector

member mounted internally of the trunk on or close to a wall thereof and having a width, measured in the plane of, and transversely of the direction of flow in, the layer the fuel concentration in which is to be modified by the said member, which is less than the corresponding dimension of the trunk, at the location of the said member, and means for adjusting the said deflector member between a position in which it lies substantially flush with or flat against the said internal wall and a position in which it projects inwards therefrom to an extent sufficient to effect the desired modification in fuel distribution across the trunk at the junction.

Preferably, a plurality of deflector members are mounted at spaced intervals on a plane substantially perpendicular to the width of the trunk.

Advantageously, deflector members are mounted on a plurality of walls of a trunk of polygonal cross-section, and may be arranged in sets each set having independent means for the adjustment thereof.

Conveniently, a set of deflector members may be mounted on a common spindle about which they can be pivoted, or on which they may be secured for common pivotal movement. Two such sets of deflector members may be mounted on opposite walls of a rectangular section trunk at the same location therein, and a further two sets may be similarly mounted on the other walls of the trunk at a location spaced axially from the first.

In order that the invention may be more clearly understood, one example of a construction in accordance therewith, as fitted to a vertical rectangular trunk upstream from a junction therein, will now be described by way of example with reference to the accompanying drawings, which show in cross-section two similar trunk sections inserted into a pulverised fuel trunk immediately in advance of the junction and in which:

Fig. 1 is a cross-section through the two sections on the line I—I of Fig. 2, and

Fig. 2 is a cross-section through the two sections on the line II—II of Fig. 1, the bearings for one of the operating shafts being shown in cross-section.

Figs. 3 and 4 illustrate an alternative construction of deflector member;

Fig. 5 is a sectional elevation of a modified form of deflector member;

Fig. 6 is a sectional plan on the line VI—VI of Fig. 5;

Fig. 7 is a sectional plan, similar to Fig. 6, of a further modification, and

Fig. 8 is a sectional elevation of the arrangement shown in Fig. 7.

The main trunk 1 from a coal pulverising mill (not shown) to a distribution point is of rectangular cross-section and runs vertically immediately before or upstream from the junction 2 at which it divides into two branches 1*a*, 1*b* (Fig. 1) supplying pulverised coal to separate furnaces or other consuming devices (not shown). Immediately before the junction 2 there are inserted into the trunk 1 two short equal deflector sections 3, 4. The deflector section 3 adjacent the junction 2 has the upper parts 31*a*, 32*a* of a pair of opposite walls 31, 32 (Fig. 1) spaced apart by a distance slightly greater than the corresponding transverse dimension of the trunk 1. Against the inner surface of each of these wall parts 31*a*, 32*a* lies a set of three deflector members in the form of fingers 5, 6 respectively. The fingers 5, 6 are secured at their lower ends to transverse operating spindles 7, 8 respectively. The spindle 8 is mounted in a bearing 9 (Fig. 2) in the third wall 33 of the section 3 and a bearing 10 in the fourth wall 34, the bearing 9 containing a gland 9*a*. The spindle 7 is similarly mounted in the wall 33 by a gland bearing 11 (Fig. 1) similar to the bearing 9 and in the wall 34 by another bearing (not shown) similar to the bearing 10, as will be understood. Each spindle 7, 8 is of reduced diameter in its bearings, and projects through the gland bearing 11, 9 respectively to carry a respective handle 12, 13. The spindles 7, 8 are accommodated respectively in open circular section recesses 31*b*, 32*b* in the respective adjacent walls 31, 32, these walls having their lower ends 31*c*, 32*c* below the recesses space apart by the same distance as the corresponding walls of the main trunk 1. The inward-facing surfaces of the walls parts 31*c*, 32*c* are flush with the inward facing surfaces of the respective sets of fingers 5, 6.

The lower deflector section 4 is similar to the upper section 3, but is turned through 90° with respect to the latter about the axis of the main trunk 1. The walls 43 and 44 are flat and are spaced apart by a distance equal to the corresponding dimension of the main trunk 1 and carry the bearings for transverse spindles 17, 18. These spindles each carry three deflector fingers 15, 16 respectivelv which lie, in their inoperative positions, against the inward surface of the respective upper portions 41*a*, 42*a* of the walls 41, 42. The spindles are housed in recesses 41*b*, 42*b* respectively below which the wall parts 41*c*, 42*c* are spaced apart by the distance between the corresponding walls of the main trunk 1.

In both trunk sections, the spindles 7, 8, 17, 18 are independently rotatable through about 30° by their respective handles 12, 13, 112, 113 to cause the associated fingers

5, 6, 15, 16 to project to the desired extent into the stream of pulverised fuel passing up through the trunk 1 to the junction 2. Each handle is clamped in the desired position of adjustment by means of a butterfly unit 20 threaded on a bolt 21 which is secured in the handle and passes freely through an arcuate slot 22 in a quadrant 23. The quadrant 23 is mounted on pillars 24 welded to the adjacent side 33, 43 of the respective deflector section 3, 4.

In use, when pulverised coal is drawn or blown through the main trunk 1 and is to be divided at the junction 2 to feed say, two separate burners in a furnace or two separate sets of burners in different furnaces, the deflector fingers 5, 6, 15, 16 are adjusted empirically until the proportions of pulverised coal in the two branches 1*a*, 1*b* are equal. This equalisation is brought about by the deflection across the main stream immediately ahead of the junction 2 of alternate "layers" of the stream by one or more of the sets of fingers 5 so that, if there is a greater concentration of pulverised coal particles adjacent one of the walls of the main trunk 1, this concentration is effectively broken up by the deflector fingers mounted on the corresponding wall of one of the sections 3, 4, and oblique currents are set up in the main stream which result in an equal division at the junction 2 of the particles of coal between the two branch streams. The device thus operates effectively to produce the same result as is obtained by the above described method of sub-dividing the main stream into layers, first across one section and then across a section at right angles thereto, and recombining alternate subdivisions.

It will be understood that it may not always be necessary to provide two deflector sections 3, 4 arranged at 90° to each other and each having two sets of deflector fingers 5, 6 and 15, 16 respectively. For example, it may be found in practice that for a given trunk 1 under all conditions of load the concentration of entrained particles of pulverised fuel is always greatest along one particular wall of the trunk. In such circumstances it may be quite sufficient to employ only one set of deflector fingers 5 before the junction 2 to project into the layer adjacent this wall and to deflect alternate sections of it across the main stream at such an angle as to produce an equal distribution of the pulverised fuel in the two branches 1*a*, 1*b*. On the other hand, two sets of fingers (say, 5, 15) at right angles to each other may be all that is required to produce the desired result. In this case one set of fingers would normally be mounted beyond the other in the main trunk.

The angle at which the deflector fingers 5 are set with respect to the axis of flow may be automatically adjustable. Thus, it may be found that the angle is a simple function of the load on the main trunk 1, and means sensitive to this load may be arranged to move the fingers to the correct inclination.

The deflector fingers in two oppositely disposed sets 5 and 6 or 15 and 16 are preferably staggered in relation to each other, each finger of one set 5 or 15 being located opposite a gap between two adjacent fingers of the other set 6 or 16. Thus the deflected current set up by a finger is caused to interleave with similar but oppositely directed currents set up by fingers of the other set. In this way intimate mixing of the particles of pulverised fuel in the main stream is promoted.

The deflector fingers or plates 5 may be of any convenient material, and the number thereof in a set may be varied to suit local conditions. The fingers of a set may also be arranged—for example on sleeves on the spindle—to be rotated independently of each other if so desired.

The shape of the fingers may be other than flat, as shown in Figs. 3 and 4 they may be constituted by flat plates 25 whose planes are skewed or twisted with respect to the axis of the spindle 27 on which they are mounted to give a still further modification of the flow in the main trunk. Alternatively, as shown in Figs. 5 and 6, the deflector fingers may be sector-shaped in side elevation as shown at 35 in Figs. 5 and 6, and housed in triangular shaped pockets 36 in the adjacent wall 31 when in the inoperative position. If preferred, the deflector plates may be collapsible in the manner of a fan, as shown at 35*a* in Figs. 7 and 8, enabling the size of the pocket 36 to be reduced.

As will be understood, the deflector plates or fingers 5 may be of any preferred shape and size to produce a desired modification of the streamline flow through the trunk 1, or to avoid excessive turbulence on the downstream side thereof.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A pulverised fuel system of the kind described wherein a fuel distributor is located upstream from the junction and comprises a deflector member mounted internally of the trunk on or close to a wall thereof and having a width—measured in the plane of, and transversely of the direction of flow in, the layer the fuel concentration in which is to be modified by the said member—which is less than the corresponding

dimension of the trunk at the location of the said member, and means for adjusting the said deflector member between a position in which it lies substantially flush with or flat against the said internal wall and a position in which it projects inwards therefrom to an extent sufficient to effect the desired modification in fuel distribution across the trunk at the junction.

2. A pulverised fuel distributor according to Claim 1 wherein a plurality of deflector members are mounted at spaced intervals in a plane substantially perpendicular to the width of the trunk.

3. A pulverised fuel distributor according to Claim 1 or 2 wherein the deflector member or members is or are pivotally mounted.

4. A pulverised fuel distributor according to Claim 1, 2 or 3 wherein the trunk is of polygonal cross-section — preferably rectangular—at the location of the deflector member or members.

5. A pulverised fuel distributor according to Claim 4 wherein deflector members are mounted on a plurality of walls of the trunk.

6. A pulverised fuel distributor according to Claim 5 wherein the deflector members are arranged in sets each set having independent means for the adjustment thereof.

7. A pulverised fuel distributor according to Claim 6 wherein a set of deflector members is mounted on a common spindle about the axis of which they are pivotally movable.

8. A pulverised fuel distributor according to Claim 6 wherein the deflector members of a set are secured on a common spindle.

9. A pulverised fuel distributor according to any one of Claims 4—8 wherein the trunk is of rectangular section and a set of deflector members is mounted on each of a pair of opposite sides of the trunk.

10. A pulverised fuel distributor according to Claim 9 wherein a further two sets of deflector members are mounted, one on each of the other two walls of the trunk at a location spaced axially of the trunk from the location of the other two sets.

11. A pulverised fuel distributor according to Claim 1 constructed and arranged to operate substantially as described and as shown in Figs. 1 and 2, Figs. 3 and 4, Figs. 5 and 6, or Figs. 7 and 8 of the accompanying drawings.

Dated this 18th day of June, 1948.

For the Applicants,
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Chartered Patent Agents.

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637,319 COMPLETE SPECIFICATION

SHEET

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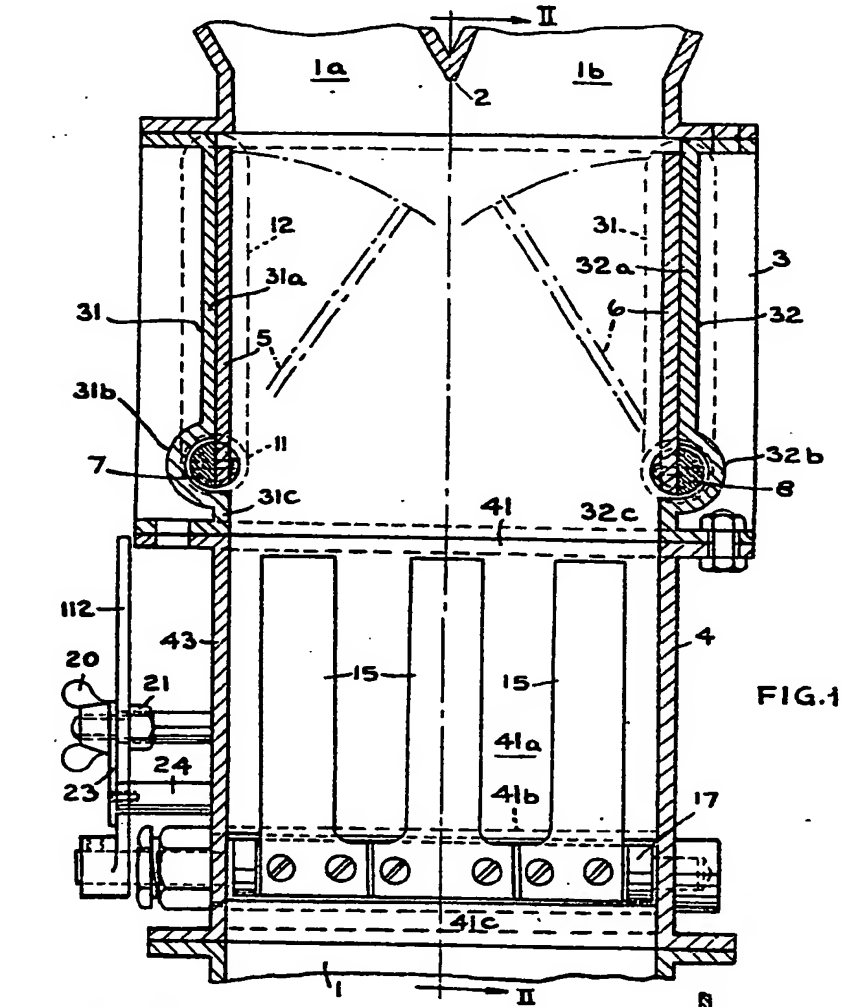

FIG.1

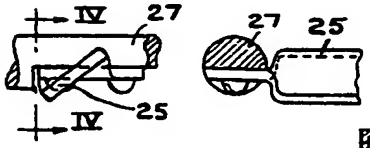

FIG.3

FIG.4

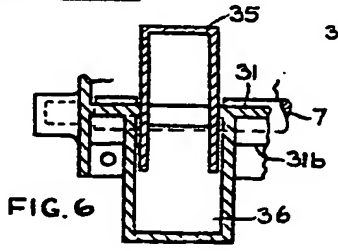

FIG.6

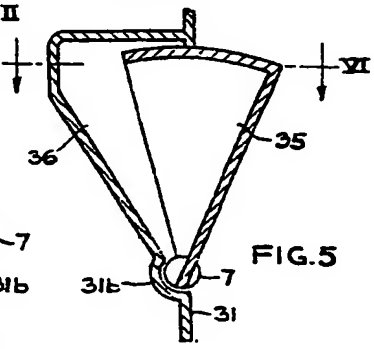

FIG.5

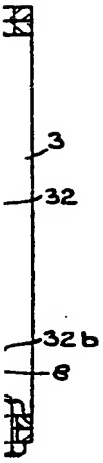

FIG.1

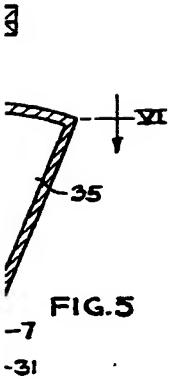

FIG.5

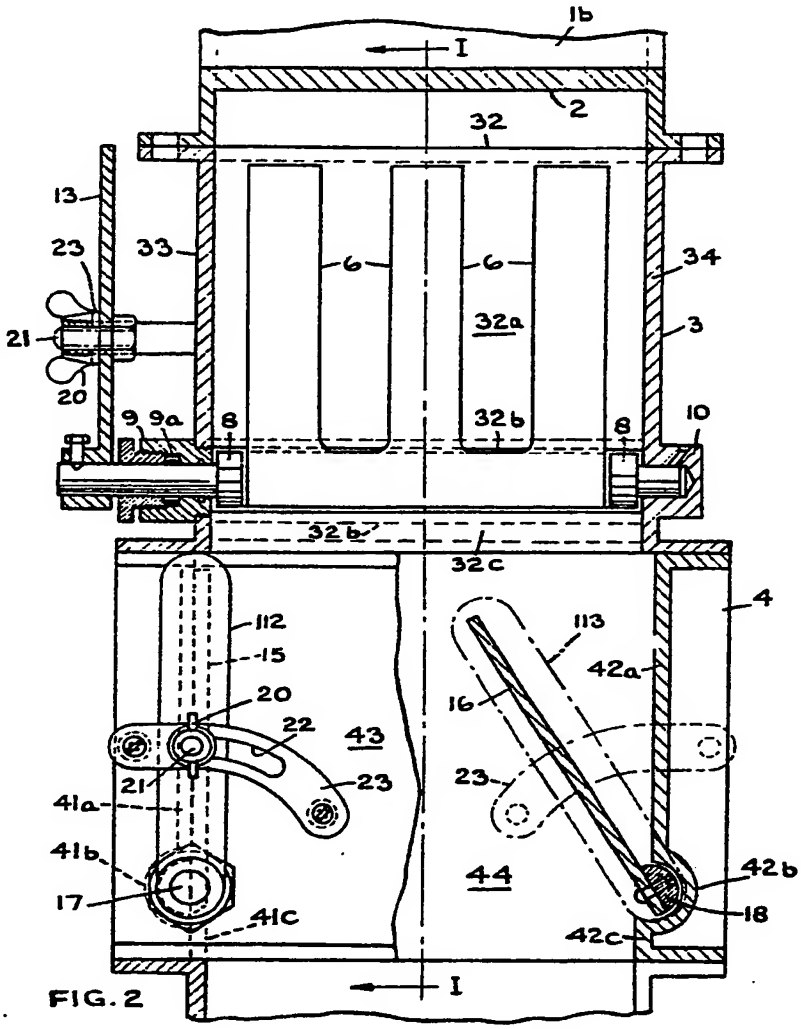

FIG. 2

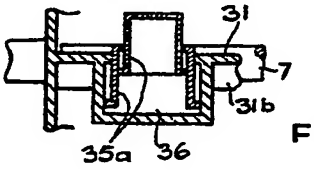

FIG.7

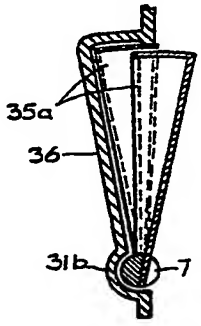

FIG.8

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637,319 COMPLETE SPECIFICATION

2 SHEETS

SHEET 1

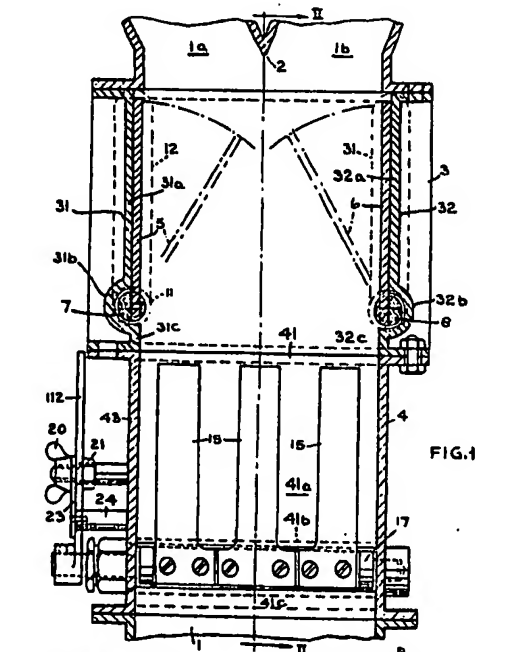

FIG.1

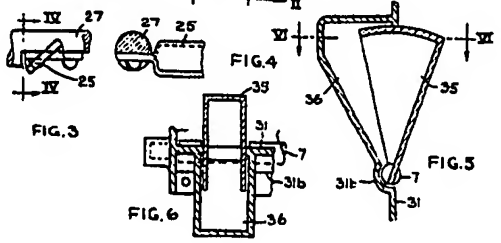

FIG.3

FIG.4

FIG.6

FIG.5

SHEET 2

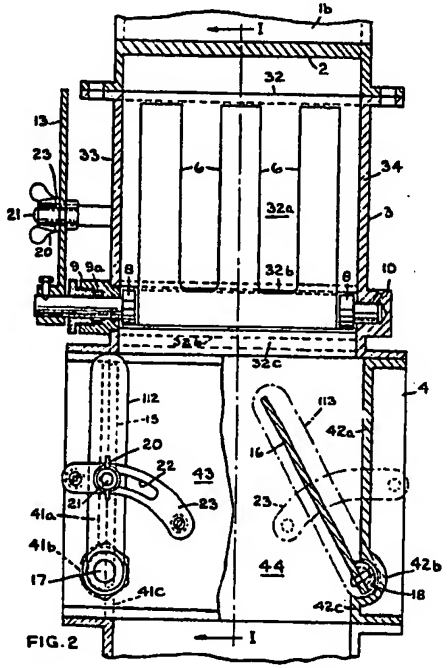

FIG.2

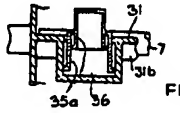

FIG.7

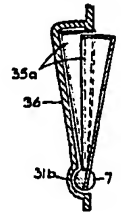

FIG.8

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H.M.S.O.(T.P.)

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